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MUETING, RAASCH & GEBHARDT, P.A.			STULTZ, JESSICA T	
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MINNEAPOLIS, MN 55458			PAPER NUMBER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/019,521	Applicant(s) SCHILLER, PETER J.	
	Examiner Jessica T Stultz	Art Unit 2873	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9, 11-20 and 23-27 is/are rejected.
- 7) ☒ Claim(s) 10, 21 and 22 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 October 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 5-6, 8-9, 11, 15-16, 18-20, 23, and 26-27 are rejected under 35 U.S.C. 102(b) as being anticipated by Mastrangelo.

Regarding claim 1, Mastrangelo discloses a method of manufacturing a micro-electromechanical device having front and back sides (Shown in Figures 4A-O), the method comprising: providing a substrate comprising a first side located proximate the front side of the device and second side proximate the back side of the device (Column 6, lines 3-18, wherein the substrate is silicon wafer “10”, Figures 4A-O); providing a sacrificial material on a selected area of the first side of the substrate (Column 6, lines 3-18, wherein the sacrificial material is the etch-stop area “20”, Figure 4A); providing a diaphragm layer on the sacrificial material and the first side of the substrate surrounding the sacrificial material in the selected area (Column 6, lines 19-23, wherein the diaphragm layer is silicon layer “30”, Figure 4B); providing at least one transducer on the front side of the device (Column 6, lines 19-Column 8, line 9, wherein the transducers comprise bottom electrodes “40” and top electrodes “60”, Figures 4D-O), the transducers located over the sacrificial material (Shown in Figures 4D-O), wherein the transducers comprise transducing material and electrical contacts in electrical communication with the transducing material (Column 6, line 19-Column 8, line 9, wherein the electrical

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contacts are electrode holes "80a-80c" and LTO layers "50" and "66", which contact both electrodes "40" and "60", Figures 4E-K); forming a void in the substrate from the second side of the substrate towards the first side of the substrate after providing the transducer on the front side of the device (Column 7, lines 11-28, wherein the void is formed by a silicon etch solution, Figure 4H); wherein at least a portion of the sacrificial material is exposed within the void proximate the first side of the substrate (Shown in Figure 4H, wherein the etch stops at the etch stop "20"); and removing at least a portion of the sacrificial material through the void, wherein a portion of the diaphragm layer is suspended directly above the substrate within the selected area (Column 7, lines 11-28, wherein the layer "20" is removed and the diaphragm layer "30" is suspended, Figure 4I).

Regarding claim 3, Mastrangelo further discloses a method of manufacturing a micro-electromechanical device as disclosed above wherein the void is formed by etching the substrate while the electrical contacts are exposed on the front side of the device (Column 6, line 63-Column 7, line 28, wherein the void is formed by a silicon etch solution, wherein the electrical contact LTO layer "66", which connects upper electrode "60" and the lower electrode "40", is exposed Figures 4G-H).

Regarding claim 5, Mastrangelo further disclose that removing the sacrificial material comprises selectively etching the sacrificial material (Column 7, lines 11-28, wherein the void is formed by a silicon etch solution, Figures 4H-I).

Regarding claim 6, Mastrangelo further discloses that removing the sacrificial material comprises selectively etching the sacrificial material by exposing only the backside of the device to an etchant (Column 7, lines 11-28, Figures 4H-I).

Regarding claim 11, Mastrangelo further discloses a method of manufacturing as disclosed above wherein the void comprises an opening within the selected area on the first side of the substrate that is smaller than the selected area occupied by the sacrificial area (Shown in Figures 1 and 4I-O).

Regarding claim 15, Mastrangelo discloses a substrate assembly having front and back sides (Shown in Figures 4A-O), the assembly comprising: a substrate comprising a first side located proximate the front side of the device and second side proximate the back side of the substrate assembly (Column 6, lines 3-18, wherein the substrate is silicon wafer "10", Figures 4A-O); sacrificial material on the first side of the substrate in a plurality of selected areas (Column 6, lines 3-18, wherein the sacrificial material is the etch-stop area "20", Figure 4A); a diaphragm layer covering the sacrificial material in the selected areas (Column 6, lines 19-23, wherein the diaphragm layer is silicon layer "30", Figure 4B), the diaphragm layer extending to cover the first side of the substrate surrounding the sacrificial material in the selected areas (Shown in Figure 4B); a plurality of transducers on the front side of the device, each of the transducers located over at least a portion of each of the selected areas (Column 6, lines 19-Column 8, line 9, wherein the transducers comprises the bottom electrodes "40" and the top electrodes "60", Figures 4D-O), wherein the transducer comprises transducing material and electrical contacts in electrical communication with the transducing material (Column 6, line 19-Column 8, line 9, wherein the electrical contacts are electrode holes "80a-80c" and LTO layers "50" and "66", which contact both electrodes "40" and "60", Figures 4E-K), wherein the sacrificial material in the selected areas is encapsulated between the substrate and the diaphragm layer (Shown in Figures 4B-4G).

Regarding claims 2 and 16, Mastrangelo further discloses a method of manufacturing a micro-electromechanical device and a device as disclosed above wherein the suspended portion of the diaphragm layer and the substrate form an included angle at their junction of less than 90 degrees (Shown in Figures 1 and 4I-O).

Regarding claim 18, Mastrangelo further discloses that the micro-electromechanical device as disclosed above include the sacrificial material being selectively removable with respect to the diaphragm layer and the substrate (Column 7, lines 11-28, wherein the layer "20" is removed, Figure 4I).

Regarding claim 23, Mastrangelo discloses a micro-electromechanical device having front and back sides (Shown in Figures 4A-O), the device comprising; a substrate comprising a first side located proximate the front side of the device and second side proximate the back side of the device (Column 6, lines 3-18, wherein the substrate is silicon wafer "10", Figures 4A-O); a void formed through the first and second sides of the substrate (Column 7, lines 11-28, wherein the void is formed by a silicon etch solution, Figure 4H), the void formed comprising an opening proximate the first side of the substrate (Shown in Figure 4H); and a diaphragm layer spanning the opening proximate the first side of the substrate (Column 6, lines 19-23, wherein the diaphragm layer is silicon layer "30", Figure 4B); and a diaphragm layer spanning the opening in the first side of the substrate and attached to the first side of the substrate (Shown in Figures 1 and 4I-O), wherein a portion of the diaphragm layer and the substrate form an included angle at their junction of less than 90 degrees (Shown in Figures 1 and 4I-O).

Regarding claim 26, Mastrangelo discloses a micro-electromechanical device as disclosed above comprising a transducer on the diaphragm layer, (Column 6, lines 19-Column 8,

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line 9, wherein the transducers comprises the bottom electrodes "40" and the top electrodes "60", Figures 4D-O) wherein the transducer is located above at least a portion of the suspended portion of the diaphragm layer (Figures 4D-O).

Regarding claims 8-9, 19-20, and 27, Mastrangelo further discloses a method of manufacturing and a device as disclosed above wherein providing the sacrificial material comprises depositing a layer of the sacrificial material on the first side of a planar substrate in the selected area (Figure 4A).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4, 7, 12-14, 17, and 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo in view of Ishida et al.

Regarding claims 4 and 17, Mastrangelo discloses the method of manufacturing a device and a device as disclosed above with electrical contacts wherein the void is formed by etching through the substrate while the contacts are exposed on the front side of the device (Column 6, line 63-Column 7, line 28, wherein the void is formed by a silicon etch solution, wherein the electrical contact LTO layer "66", which connects upper electrode "60" and the lower electrode "40", is exposed Figures 4G-H), but does not specifically disclose that the contacts are metallic. Ishida et al teaches of a MEMs device (accelerometer sensor "1") wherein a void is made (Figure 12) and a sacrificial layer is removed (Figure 13) specifically wherein electrical contacts are

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metallic (Column 3, lines 46-55, wherein the wiring contacts “12” are aluminum, which connect to bonding pads “13”, Figure 2a) for the purpose of connecting the sensor to external devices or circuits (Column 3, lines 56-67). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made for the method of manufacturing a device and the device of Mastrangelo further include the use of metallic electrical contacts since Ishida et al teaches of a MEMs device wherein a void is made and a sacrificial layer is removed specifically wherein electrical contacts are metallic for the purpose of connecting the sensor to external devices or circuits.

Regarding claim 7, Mastrangelo discloses the method of manufacturing a device as disclosed above but does not specifically disclose that the etchant is in a gas phase. Ishida et al teaches of a MEMs device (accelerometer sensor “41”) wherein a void is made (Figure 17) and a sacrificial layer is removed (Figure 17) specifically wherein the etchant in a gas phase (Column 9, lines 45-50 and Column 10, lines 48-53) for the purpose of performing reaction ion etching rather than non-reactive etching (Column 10, lines 48-53). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made for the method of manufacturing of Mastrangelo further include the use of metallic electrical contacts since Ishida et al teaches of a MEMs device wherein a void is made and a sacrificial layer is removed specifically wherein the etchant in a gas phase for the purpose of performing reaction ion etching rather than non-reactive etching.

Regarding claims 12-13 and 24, Mastrangelo discloses the method of manufacturing a device as disclosed above but does not specifically disclose that the void in the substrate comprises a proof mass attached to the diaphragm layer, the proof mass comprising a portion of

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the substrate that is separated therefrom, wherein the void is in the shape of an annular ring and the proof mass is cylindrical. Ishida et al teaches of a MEMs device (accelerometer sensor “36”) wherein a void is made (Figure 16) and a sacrificial layer is removed (Figure 16) specifically comprises a proof mass attached to the diaphragm layer (Column 9, lines 51-50, wherein the proof mass is the portion “37”), the proof mass comprising a portion of the substrate that is separated therefrom (Shown in Figure 16), wherein the void is in the shape of an annular ring and the proof mass is cylindrical (Column 9, lines 51-60, wherein the void is an annular ring and the proof mass “37a” is cylindrical, Figure 16) for the purpose of providing improved sensitivity of the accelerometer sensor due to the increased mass of the proof mass (Column 9, lines 61-67). Therefore it would have been obvious to one having ordinary skill in the art at the time the invention was made for the for the method of manufacturing of Mastrangelo further include the void in the substrate comprising a proof mass attached to the diaphragm layer, the proof mass comprising a portion of the substrate that is separated therefor, wherein the void is in the shape of an annular ring and the proof mass is cylindrical since Ishida et al teaches of a MEMs device wherein a void is made and a sacrificial layer is removed specifically comprising a proof mass attached to the diaphragm layer, the proof mass comprising a portion of the substrate that is separated therefrom wherein the void is in the shape of an annular ring and the proof mass is cylindrical for the purpose of providing improved sensitivity of the accelerometer sensor due to the increased mass of the proof mass.

Regarding claims 14 and 25, Mastrangelo further discloses a method of manufacturing a micro-electromechanical device and device as disclosed above wherein the suspended portion of

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the diaphragm layer and the substrate form an included angle at their junction of less than 90 degrees (Shown in Figures 1 and 4I-O).

Allowable Subject Matter

Claims 10 and 21-22 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for allowance: none of the prior art alone or in combination disclose or teach of the claimed combination of limitations to warrant a rejection under 35 USC 102 or 103.

Specifically regarding claims 10 and 21-22, none of the prior art alone or in combination disclose or teach of a method of manufacturing a device or a device as disclosed above specifically wherein the sacrificial material is reflowable, and wherein the method further comprises reflowing the sacrificial material.

Response to Arguments

Applicant's arguments filed January 29, 2004 have been fully considered but they are not persuasive. Specifically, regarding independent claims 1 and 15 applicant argues that the Mastrangelo reference does not show a sacrificial material "provided on" or "located on" the first side of the substrate. Examiner disagrees because Mastrangelo discloses that the sacrificial material "20" is deposited on the substrate "10" (Column 6, lines 4-29, shown in Figure 4A), the resist "12" is removed and an additional silicon layer "30" is grown on top of the sacrificial material "20" (Column 6, lines 4-29, Figure 4B). Therefore the sacrificial material "20" is located or provided on the first substrate "10" and then an additional layer "30" is added on form

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a diaphragm. Specifically the diaphragm layer and the substrate are differentiated throughout the other Figures 4A-O as being separate layers, they are merely the same shading since they are both made of silicon.

Regarding independent claim 23 and dependent claims 14, 16, and 25, applicant argues that the Mastrangelo reference does not show a diaphragm layer located on the surface of the substrate and therefore the angular relationship cannot be determined between the diaphragm and the substrate. Examiner disagrees because Mastrangelo discloses separate diaphragm and substrate layers, specifically wherein the substrate is "10" and the diaphragm layer is "30", which are differentiated throughout the other Figures 4A-O as being separate layers; they are merely the same shading since they are both made of silicon. Mastrangelo further discloses that the resist "12" is removed from substrate "10" and an additional silicon layer "30" is grown on top of the sacrificial material "20" (Column 6, lines 4-29, Figure 4B). Therefore the diaphragm layer "30" and the substrate "10" are separate entities and the included angle at their junction is less than 90 degrees (Shown in Figures 1 and 4I-O).

Specifically regarding claims 4 (and therefore 17) applicant claims that the Ishida et al reference does not show metallic contacts formed before the etching. In response to applicant's argument that the Ishida et al reference does not have metallic contacts formed on the front side of the devices before the etching, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

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Specifically, the Mastrangelo reference discloses electrical contacts formed prior to etching (Column 6, line 63-Column 7, line 28, wherein the void is formed by a silicon etch solution, wherein the electrical contact LTO layer “66”, which connects upper electrode “60” and the lower electrode “40”, is exposed Figures 4G-H), but does not specifically disclose that the contacts are metallic. Ishida et al is combined with this reference to specifically show motivation for making the electrical contacts within a similar system metallic.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.


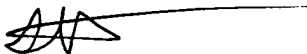
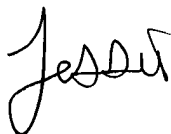
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jessica T Stultz whose telephone number is (571) 272-2339. The examiner can normally be reached on M-F 8-4:30.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Georgia Epps can be reached on 571-272-2328. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jessica Stultz
Patent Examiner
AU 2873
April 1, 2004



JORDAN SCHWARTZ
PRIMARY EXAMINER